X-ray Fluorescence Studies of Electrochemical Systems

Scientific Achievement

In-situ x-ray fluorescence spectroscopy is used to study various electrochemical systems. A few examples are given where the techniques are used to study the surfaces of electrocatalysts.

Methanol tolerant Se/Ru oxygen reduction catalyst: Se covered nanoparticles of Ru catalyst was bonded on a carbon pellet with Nafion. XAFS data taken at different potentials at the Se K edge reveals that the dominant Se-Ru bonds indicate that electronic modification of Ru by Se is likely the explanation of the high catalytic activity of this catalyst (Electronic Effect).

CO absorption/oxidation induced electrochemical annealing of Pt nanoparticle catalysts: X-ray fluorescence measurement is well suited for obtaining fundamental scientific data on real commercial catalysts. We have investigated the CO oxidation of Pt catalysts manufactured by E-TEK inc. Using a high-resolution mode, we found that the CO cycles can induce the nanoparticle catalysts change the structure of nanoparticles. In particular, CO modifies the underlying nanoparticle shape so that it increases the long-range ordering and can bind more tightly.

High temperature Solid Oxide Fuel Cells (SOFC) enable highly efficient conversion of chemical energy into electrical energy. The performance of the $La_{0.8}Sr_{0.2}MnO_3$(LSM) cathode shows long term improvement by current conditioning. Contrary to the common knowledge, we find no measurable chemical shifts in Mn or La upon the current conditioning. The results point to structural transformation or elemental migration, rather than chemical changes, for the cause of the reversible or irreversible activation by the current conditioning.

Significance

Our measurements demonstrated the sensitivity of our techniques to the buried interfaces of nanoparticles and their oxidation states. We will study nanoparticle electrocatalysts important to various fuel cells, in situ under respective operating conditions using advanced x-ray fluorescence techniques. [A review chapter to “In-situ Spectroscopic Studies of Adsorption at the Electrode and Electrocatalysis”, ed. S. Sun, P.A. Christensen, A. Wieckowski, Elsevier, 2006 in press.]

Performers

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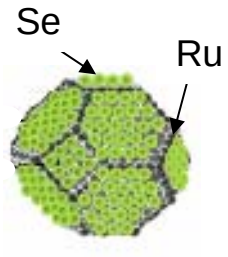

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